Theses

Thesis 1

Using parameter ranges determined through analysis of injection and spray formation process in diesel engines, I accomplished numerical simulations by means of a CFD software widely used in automotive development. I demonstrated that the location of droplet sampling significantly influences comparability of SMD and droplet size distribution with measurement data. Corresponding to the characteristics of Discrete Droplet Method I proposed use of a sampling plane. For location of this plane I proposed a distance from injector nozzle orifice that takes both child droplet production and threshold of measurability of droplet size into account (Chapter 6.3.1).

Thesis 2

2.1 Using the methodology determined in Thesis 1 I demonstrated that original implementation of child droplet production mechanism leads to bimodality of droplet size distribution under high injection pressure and high ambient gas pressure conditions (Chapter 6.3). I proposed a non-dimensional number capable of describing quantitatively the level of bimodality (Chapter 6.4).

2.2 I showed that in case of high level of bimodality the spatial droplet size distribution in simulated spray cone is different from that in measurements (Chapter 6.6).

2.3 Based on theoretical considerations and numerical experiments I determined the parameters affecting bimodality and the extent of their influence (Chapter 6.5).

Thesis 3

3.1 Based on the results summarized in Thesis 1 I initiated and participated in development of new models of child droplet production. Based on results of numerical experiments with these models I proposed a new model of child droplet production that properly describes real life processes (Chapter 7.2). This model is available in the latest version of the software applied.

3.2 Based on comparison of simulation results with measurement data I proposed use of the collision and coalescence model providing best agreement with measurement data (Chapter 8.1.1).

3.3 I validated the proposed child droplet production model with measurement data stemming from further four injector nozzles having different injector bore diameters and lengths, and I found good agreement for all cases (Chapter 8.2.2).